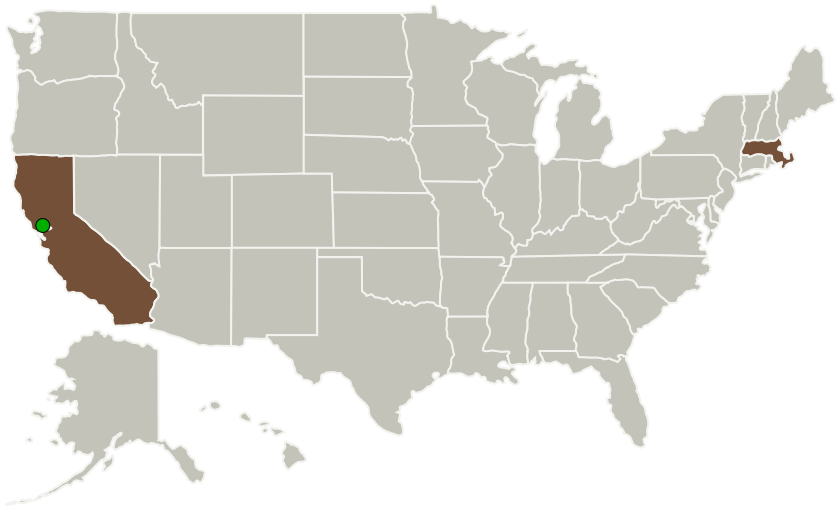
Hybrid Direct Drive PPU for Deep Space CubeSat Propulsion System, Phase I

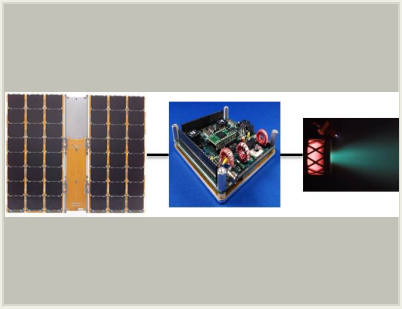
Completed Technology Project (2015 - 2015)

Project Introduction

Busek proposes to develop an innovative, hybrid direct-drive (HDD) Power Processing Unit (PPU) for CubeSat electric propulsion (EP) systems. The technological approach is an adaptation of a Busek patented technology, US patent number 8,550,405, entitled "Solar Powered Spacecraft Power System for a Hall Effect Thruster." This technology will immediately benefit the deep space 6U CubeSat currently being developed under NASA's "LunarCube" program, which is equipped with Busek's groundbreaking, iodine-fueled RF ion thruster BIT-3. The HDD concept will take advantage of the solar array's raw voltage, which is much higher than the conditioned voltages typically supplied by the spacecraft's electrical power system (EPS), and directly feeds it into the propulsion system's PPU to minimize efficiency losses during high-voltage conversion. The end result is increased available power for thruster utilization, which in turn can help maximize the vehicle's thrust, specific impulse (Isp) and delta-V maneuverability during the continuous-thrusting phase of the mission. Operating the ion thruster at higher power will ultimately help reduce time spent on trajectory transfer, thus saving mission operation costs and lessening burden on electronics in high radiation environments. In typical Cube-Sat systems the bus voltage is quite low. This requires additional power conditioning using step up DC/DC converters when high voltages are needed (such as the grids on the BIT-3 RF ion thruster). In the proposed approach the HDD unit conditions the high voltage directly from the solar array and passes it to the PPU, thus eliminating redundant power processing of step up converters and improving system efficiency. This topology also offers the novel feature of thruster dependent peak power tracking, providing direct control of the power flow from the arrays to the PPU by throttling the thruster.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
Busek Company, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Natick, Massachusetts
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Massachusetts

Project Transitions

June 2015: Project Start

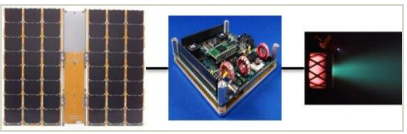
December 2015: Closed out

Closeout Summary: Hybrid Direct Drive PPU for Deep Space CubeSat Propulsion System, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image*(https://techport.nasa.gov/file/139093)*

Images



Briefing Chart Image
Hybrid Direct Drive PPU for Deep Space CubeSat Propulsion System, Phase I
(https://techport.nasa.gov/image/136449)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Busek Company, Inc.

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

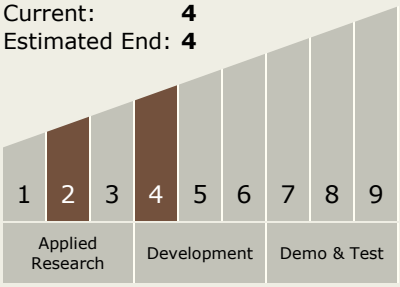
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Eric Ehrbar

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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Completed Technology Project (2015 - 2015)

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.2 Electric Space Propulsion
    - TX01.2.1 Integrated Systems and Ancillary Technologies

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System